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AGRICULTURAL Research

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Mechanical Hands

The big machine rumbles into the field and straddles a row of vines. A blade whirls and a complex of conveyors and rubber-covered "fingers" go into action. As the machine moves forward it cuts and picks up tomato vines, strips off the fruits, and leaves the debris behind.

Tomato growers have joined the ranks of others who harvest mechanically. Today machines are harvesting red tart cherries, bush beans, carrots, prunes, blueberries, dates, and potatoes. And last season some of the cling peach and apple crops were machine harvested.

Thus, what had been slow, backbreaking work is eased. Mechanical harvesters may have as much impact in the 20th century as the gin and reaper did in the 19th. For today's scarcity of labor makes mechanization urgent. Indeed, farmers and consumers both benefitted when mechanical harvesters saved California's processed tomato industry.

Mechanical harvesting is not in the hands of engineers alone. Many fruits and vegetables have defied machine harvesting because of their tenderness and irregular ripening periods. Crops must be tailored for harvesting by machine. The streamlined harvesting of tomatoes is a triumph stemming from joint efforts of engineers and plant breeders. Before tomatoes could be harvested mechanically they had to be bred for simultaneous ripening and easy removal from the vine. And they had to be firm fruited and oblong shaped to reduce rolling during harvest, thereby lessening bruising.

But mechanical harvesting of fruits and vegetables is in its infancy. These crops are still largely harvested by hand for fresh market.

Horticulturists are paving the way for anticipated progress. They are changing the shape of trees to facilitate mechanization, turning peach trees into umbrella-like structures and apple and citrus orchards into long hedgerows. Tomorrow's vegetables and small fruits will be uniform in size, shape, and growth rate. They will be upright in growth habit and have fewer leaves and intertwining stems or branches.

ARS scientists and their colleagues in universities and industry will continue to modernize harvesting. This effort will enable growers to compete in the face of change and keep consumers supplied with fruits and produce.

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Editor: R. P. Kaniuka

Managing Editor: E. H. Davis

Contributors to this issue:

R. C. Bjork, J. P. Dean

M. C. Guilford, M. B. Heppner

L. W. Lindemer, D. H. Mayberry

D. P. Movitz, S. A. Oring

M. F. Tennant, M. E. Vanderhoof

D. M. Webb, A. D. Wynn

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Clifford M. Hardin, Secretary
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator
Agricultural Research Service



Cover: A Wistar rat (ST-4583-5). Left: Wistar and BHE rats at play in a confiner (ST-4583-19). The Beltsville scientists originated the BHE strain in 1942 and named it for the then-existing Bureau of Home Economics.

TO THINK OF CARBOHYDRATES as simply sources of energy is distinctly "old hat."

Studies by ARS and other nutritionists make it clear that these nutrients play a role so complex that scientists still can't answer many important questions. Getting at the answers is complicated by the fact that body reaction to carbohydrates depends at least in part on heredity and may actually involve different metabolic processes. What a certain carbohydrate does in one person's body may be quite different from what it does in his neighbor's.

Some of the most urgent carbohydrate research is concentrated on the dietary role of sucrose, furnished primarily by cane and beet sugars. Evidence indicates that sucrose may, under certain conditions, influence cholesterol metabolism. If so, it could be a factor contributing to the development of atherosclerosis, the so-called "clogging of the arteries."

To determine the effect of various carbohydrates on fat metabolism as influenced by age and heredity, a team of

many variants
in body reactions
to
CARBOHYDRATES

ARS scientists at Beltsville, Md., divided into three groups each two strains of rats, BHE and Wistar, whose fat metabolism was known to differ. Each group of rats was fed a high cholesterol diet containing 25 percent egg plus either sucrose, glucose, or cornstarch.

Changes in liver fat occurred as early as 150 days, and fat and cholesterol were higher in both strains of the animals fed sucrose.

In the BHE rats, liver weight increased with age when the diet contained sucrose, and there was a marked rise in both cholesterol and noncholesterol fats. No significant change was noted when the carbohydrate was cornstarch or glucose.

In contrast, the Wistar rats seemed to adapt with age to the high cholesterol diet. Liver weight remained unchanged and liver cholesterol levels decreased with all three carbohydrates, but remained higher with sucrose in the diet.

Cholesterol levels of the blood serum from both rats changed more slowly than the amount of liver cholesterol, and differences due to carbohydrates were generally small. However, by 350 days, differences in the cholesterol levels of both strains were highly significant.

In spite of some relatively high liver fat levels in 350-day-old BHE rats compared with Wistar rats, survival of the BHE rats fed cornstarch or glucose, but not sucrose, was similar to that of Wistar rats fed comparable diets. When the dietary carbohydrate was sucrose, survival of the BHE rats was significantly reduced. Their average age at death was 444 days. Wistar rats fed sucrose lived to 583 days, or 139 days longer. The type of carbohydrate had no significant influence on survival of the Wistar rats.

One criterion for determining response to different diets involves measuring the concentration of vari-

ous proteins in the blood. By separating these proteins into their components, scientists found that one component, pre-albumin, was particularly susceptible to dietary carbohydrates. In addition, the level of pre-albumin in the blood correlated directly with fat level in the blood, suggesting that this component may play a role in fat movement.

Differences due to carbohydrate intake were seen more frequently in blood obtained from rats after an overnight fast than from nonfasted animals. In the BHE strain, level and incidence of pre-albumin increased with age in the blood of fasted animals fed diets containing sucrose or starch. Extremely high levels were observed with sucrose.

With glucose, the level of pre-albumin was consistently low. In the Wistar rats fed sucrose, the level was high at 150 days, but low at 350. At the latter age no significant differences due to carbohydrate were apparent. ■



Above: Biologist Murray Fisher prepares liver tissue for microscope examination. BHE livers showed more fat regardless of the diet and the greatest amount of fat when carbohydrate was sucrose (N-33258). Right: Chemist Jo Ann Lee takes blood sample for cholesterol analysis (PN-1767).

Right: Hesseltine selects *R. oligosporus* culture from the ARS Culture Collection which has also yielded a new source of the enzyme that inhibits leukemia (PN-1768). Below: Jeffrey Lee, 3, makes his own evaluation of tempeh (PN-1769).

tempeh

protein-rich food may increase disease resistance

TEMPEH, a good-tasting, oriental soy food, also has a medicinal property—it inhibits the growth of some bacteria.

Tempeh is made by inoculating cooked, whole soybeans with a mold, *Rhizopus oligosporus*, and fermenting the mixture for 24 to 36 hours. Such oriental fermented foods are studied at the ARS Northern utilization research laboratory, Peoria, Ill., as diet supplements in this and other countries and as outlets for U.S. food crops.

Scientists at the Northern laboratory recently discovered that *R. oligosporus* produces antibacterial compounds that may stimulate growth and increase disease resistance. This antibiotic effect could explain the divergence between the results of laboratory studies and the benefits observed among people eating tempeh. Analyses and results of tests with laboratory rats show no significant nutritional differences between tempeh and soybeans, but observations do.

People in Indonesia, where tempeh originated and where many diets are inadequate, claim the fermented food is better. Dutch scientists, furthermore, observed beneficial effects

among dysentery patients eating tempeh in World War II prison camps. One scientist, a prisoner himself, reported later that many undernourished prisoners found soybeans almost indigestible, but even sick prisoners could digest tempeh.

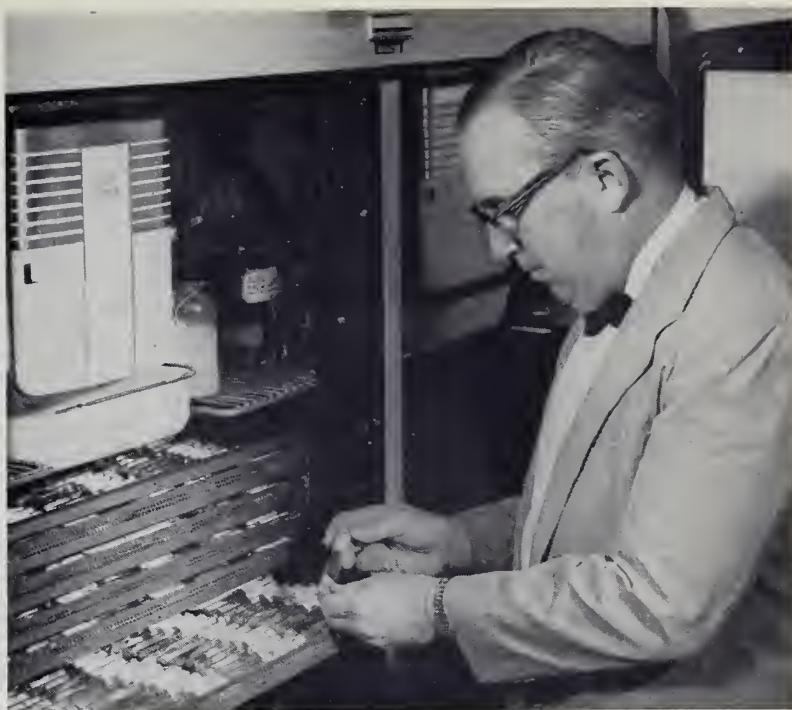
Biochemist H. L. Wang, technician D. I. Ruttle, and microbiologist C. W. Hesseltine, discovered the antibacterial compounds during a study of rennin-like materials produced by the tempeh mold. Rennin is an enzyme that curdles milk, which can then be converted to cheese by bacteria. Although these materials behaved like rennin in forming excellent milk curd, the cheesemaking bacteria would not grow in the curd.

Fractionating the milk-curdling material, the scientists found not only a rennin-like fraction containing four enzymes but also the bacteria-inhibiting fraction containing four, possibly five, compounds. No single enzyme or antibacterial compound has been isolated, but the activity of each group has been studied.

Antibacterial compounds extracted from tempeh and from *R. oligosporus* growing on skim milk or soybean meal were tested against 25 species of bacteria. Eleven species were affected

by the compounds, and nine species completely stopped growing. Four species of bacteria inhibited by the antibacterial compounds are typical inhabitants of the human intestinal tract.

The Northern laboratory work is the first report of antibacterial compounds produced by the tempeh mold. *R. oligosporus* is in the Mucorales family, which has not been known to produce such complex materials as the antibacterial compounds. ■



Yoder puts thermometer into a sand-filled bottle which will be kept with eggs getting heat treatment. Thermometer is placed so that it can be read clearly through a window (PN-1770).



Pasteurization
parallel . . .

HEAT-TREATING EGGS

halts chronic respiratory disease

A SPECIAL HEAT TREATMENT of eggs before incubation stops transmission of chronic respiratory disease in chickens.

The major infective agent of this disease is *Mycoplasma gallisepticum*, a very small bacterium. Hens may carry *Mycoplasma* organisms in the reproductive tract, and egg transmission is a major route of *Mycoplasma* infection.

Since the early 1960's, researchers have had some success in reducing egg transmission by treatments applied before incubation. Most recently, dipping eggs in antibiotics, paired with other techniques, proved helpful in cleaning up *Mycoplasma* infection from most broiler breeding flocks.

Mycoplasma eradication remains to be completed, however, in certain poultry lines. While dipping could possibly complete the eradication

program, the method has drawbacks. Some *Mycoplasma* slip through, and special material and equipment are needed.

These drawbacks can be overcome, it now appears, with a new eradication method that parallels pasteurization—heating eggs to a predetermined, moderately high temperature. ARS veterinarian H. W. Yoder, who devised the new method, says that it depends for success on achieving an internal egg temperature of 114° F. under a specified set of conditions.

The method was evaluated at the ARS Southeast Poultry Research Laboratory, Athens, Ga., when treated eggs had been incubated for 14 days—a good time to check for egg-borne infection. Results showed no *Mycoplasma* survival in eggs that had been experimentally infected.

Yoder calls 114° the critical tem-

perature because it kills the *Mycoplasma* and consistently keeps hatch of treated eggs within 8 to 10 percent of normal. Temperatures higher than 114°, while eliminating *Mycoplasma* just as completely, reduce chick hatch more drastically.

The optimum temperature was achieved in preliminary experiments by heating a batch of 40 eggs in a small incubator for 6 hours to eradicate *Mycoplasma*. Yoder found, however, that each size of load poses a different problem. The largest load he has checked was 2,000 eggs—close to a commercially feasible batch.

For this load, the incubator must run 10 to 12 hours for eggs to reach 114°; no further holding at this temperature is needed. Hot-running incubators should be adjusted to achieve the desired temperature in the 10- to 12-hour range, however. Shorter treatment is ineffective; longer treatment increases embryo damage.

Since standard incubators and equipment are used for the treatment, the only special requirement is a good mercury thermometer. The major cost is the reduced hatch, which, at the level incurred with 114°, is reasonable for the primary breeder, who does the basic breeding for the poultry industry.

“For success,” Yoder says, “the breeder must determine the temperature precisely. The best way to get a good temperature reading is to put the thermometer in a sand-filled jar or bottle and place it with the eggs. I’d buy three thermometers and test them together before use. If one reading disagreed with the others, I’d still have two readings to give me assurance the job is being done right.”

In theory, a single heat treatment cleans up forever closed breeder flocks, which do not involve outside breeding stock. But in practice, Yoder says, it may be used on successive hatches as added insurance against a slip in procedure.■

A FIELD TEST for anaplasmosis—a cattle disease costing farmers and ranchers in parts of the South and West as much as \$50 million a year—has been developed by ARS researchers.

The new test eliminates the delay of sending blood samples to laboratories for analysis. An ordinary automobile serves as the laboratory in the field and a cigarette lighter outlet as the power source. Test results are available within 10 minutes after taking a sample and about 300 cattle can be tested in a day. Thus, infected cattle can be identified and separated from the herd at the same time.

Accurate diagnosis is a first step toward controlling disease and is particularly important in the case of anaplasmosis. Without diagnostic testing,

anaplasmosis is sometimes difficult to distinguish from several other diseases that might require different treatments. Furthermore, testing identifies disease carriers, which may themselves be healthy but are reservoirs of infection for biting insects that transmit the disease to other cattle.

Scientists believe that the speed, ease, and economy of the field test, in comparison with slower, more technical and costly laboratory tests now being used, should encourage more ranchers to screen their cattle when the disease shows up in local herds or when the animals are sold.

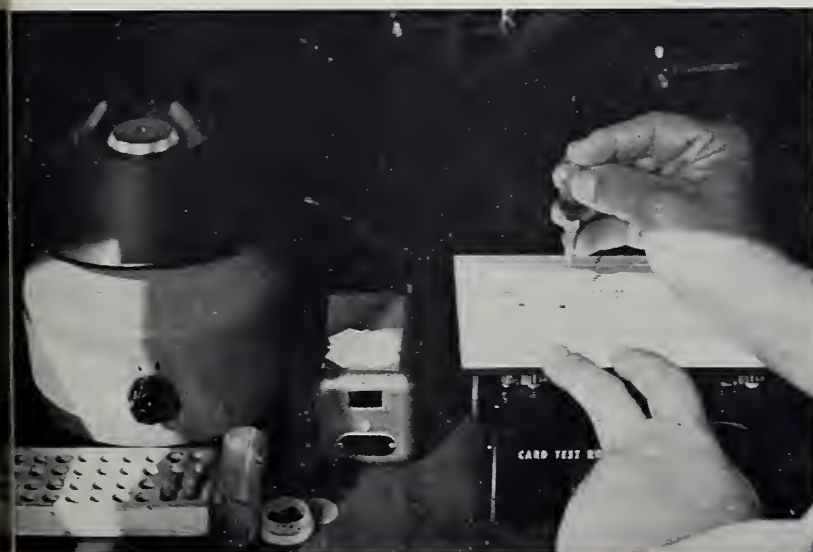
Microbiologist T. E. Amerault and veterinarian T. O. Roby developed the test at Beltsville, Md. In many cases, they say, the field test would be sophisticated enough to give conclusive evi-

dence about infection; questionable cases could be tested further by more sensitive laboratory procedures.

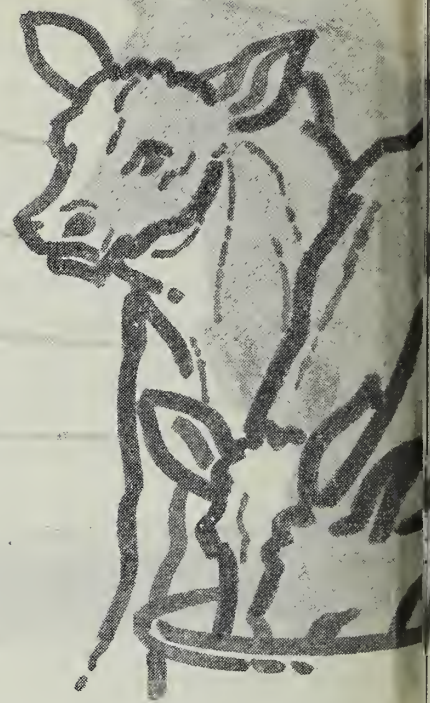
In the field test, one drop of colored antigen—a suspension of the killed disease organism—is mixed with a drop of plasma separated out of a blood sample. If the sample comes from an animal that has anaplasmosis or is a carrier of the disease, certain antibodies—substances that the blood produces in response to infection—will react with antigen to form colored clumps visible to the naked eye.

Amerault and Roby developed this antigen and procedure during several years of research. The procedure is working well in field tests and further work is underway to determine the role the new test can play in controlling anaplasmosis. ■

car-based/field test for anaplasmosis



Left top: Operator drops dot of plasma separated out of blood sample onto testing card. Left bottom: He squeezes drop of green antigen next to plasma. Above: Antigen and plasma are mixed together. They will react, and if dark green clots appear, the animal is carrying disease. (ST-4359-14, ST-4359-8, ST-4359-10).



multiple births mean more beef

THE AVERAGE BEEF COW that conceived after an experimental hormone treatment weaned 1.11 calves—up from 0.85 normally recorded in good beef herds.

The treated cows were part of a practical experiment at Fort Reno Livestock Experiment Station, El Reno, Okla., to try out available techniques for inducing multiple births. Cooperating in the trial were livestock researchers E. J. Turman of Oklahoma State University and R. E. Renbarger, and D. F. Stephens of ARS.

They injected 81 beef cows with pregnant mare serum (PMS), a substitute for the natural compound (follicle-stimulating hormone, FSH) that stimulates the ovary to produce eggs. Cows were injected twice—during the early and the late parts of the estrous cycle. Then at the end of the cycle, they were injected with chorionic gonadotrophin to assure ovulation, that is, shedding of each egg.

At the first mating following hormone treatment, 52 cows conceived. Counting only offspring that survived 1 month, they produced 29 single calves, 12 sets of twins, 8 sets of triplets, 2 sets of quadruplets, and 1

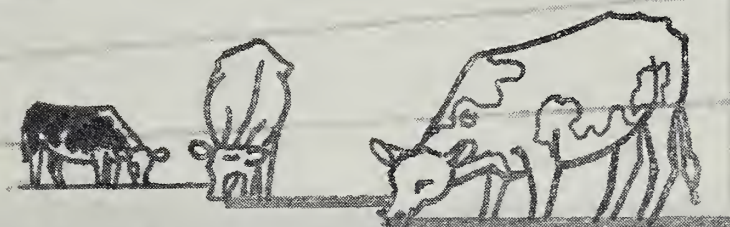
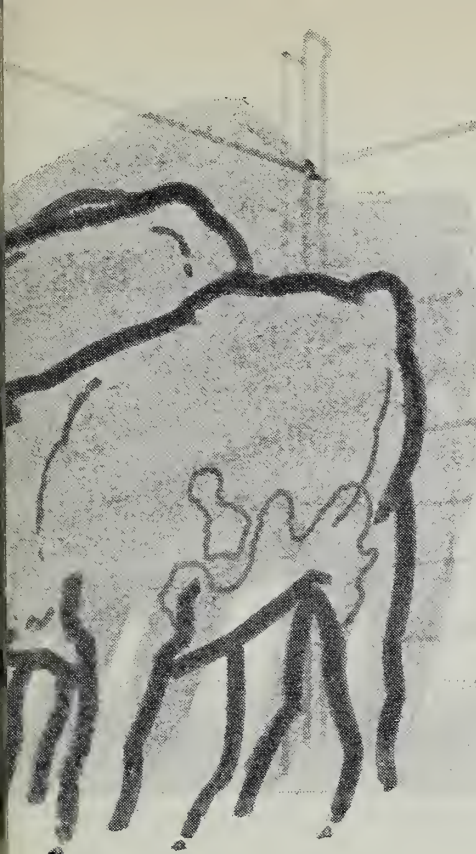
set of quintuplets. In future trials, the scientists hope to increase the number of twins and triplets without getting quads and quints, which present special management problems.

Multiples were lighter at birth than single calves. Twins and triplets averaged 55 pounds, and quads and quints averaged 34 pounds, compared with 83 pounds for single calves.

Light birth weight could be accounted for, in part, by length of gestation. It ranged from 277 days for twins to 258 days for quints compared to 281 days for single calves.

At weaning, twins and triplets averaged 374 pounds, quads and quints, 332 pounds. All were generally raised as twins, using foster mothers as needed and providing access to feed. Singles, raised as singles without feed, averaged 462 pounds. This shows, researchers emphasize, that offspring of the average cow with multiple calves produced 746 pounds of beef at weaning—more than 1½ times the output of 462 pounds recorded for cows with single offspring.

But results, while encouraging, raise a number of practical problems.



First, 48 percent of cows with multiple calves did not expel their placenta naturally, compared to 2 or 3 percent in the normal herd.

Second, 25 percent of the cows raising twins did not rebreed, perhaps in part because of the heavy stress on cows raising twins. Further, these cows did not really have enough milk for two calves. Both problems may be solved by crossing beef breeds with dairy cattle.

Third, the treatment is costly in materials and labor. Price of hormones, now about \$7 per cow treated, must be reduced by new, cheaper, mass-produced hormones or hormone substitutes. Labor costs may come down when research now underway permits workers to combine treatments for multiple births with treatments for estrous synchronization. Synchronized cows can be treated and managed as a herd rather than as individuals.

Scientists at Fort Reno and other stations will chip away at these drawbacks because the potential of multiple calves is undeniable, particularly when viewed from the standpoint of calves weaned per cow. ■

Manipulating hormone dose

To get a basic idea of how hormone dosage affects ovulation, physiologists treated 61 beef heifers, 2 and 3 years old, with follicle-stimulating hormone (FSH) obtained from pituitary glands of sheep and horses. FSH stimulates the ovary to produce eggs.

The 5-day treatment of two injections daily was started on the eighth day of estrus, which had been synchronized by feeding progesterone. Heifers were bred naturally as they came into heat. Sixty to 72 hours later, results of the entire procedure were checked by surgically examining the ovary and collecting eggs that were shed.

The best dose was 6.25 milligrams of FSH, which resulted in an average of 2.1 eggs ovulated per cow. Half that dose produced too few eggs—only 1.1 per cow. A double dose produced too many—8.0 per cow.

Furthermore, high doses of FSH caused fertilization rate of eggs to drop. The postbreeding exam showed 93.4 percent of the eggs were fertilized in heifers getting the best dose. At the double dose, fertilization rate went down to 79.4 percent.

Physiologists R. A. Bellows and R. E. Short of ARS and D. C. Anderson of Montana State University conducted the study at the U.S. Range Livestock Experiment Station, Miles City, Mont.

freeze etching...

RESearchers now have a versatile, inexpensive means of rapidly preparing biological specimens in true-to-life form for electron microscopy.

A newly modified vacuum system (module) has been developed by ARS botanist R. L. Steere for use in the freeze-etching technique he originated in 1957. Freeze-etching permits the replication of a specimen in which the specimen—living cell, virus crystal or other fragile material—can be observed or photographed under the electron microscope more accurately and clearly than possible with other techniques.

The replica virtually eliminates problems such as swelling or distortion intrinsic to using the specimen itself while providing a realistic observation in three dimensions.

Now, with Steere's improved

module, up to six specimens can be prepared simultaneously for replicating each 20 to 30 minutes—four to ten times faster than possible with other available units. Steere's module costs about \$2,800. It can be adapted for use with almost any standard vacuum unit, bringing the total cost to \$5,000 to \$8,000. Other commercially available units cost from \$12,000 to \$16,000 and are limited in capability. Only one specimen at a time can be replicated, with 6 to 16 replicas being produced daily under ideal conditions.

Cheaper models (\$500–800) are also available but are difficult to work with. They lack versatility and can also produce no more than 16 specimen replicas a day.

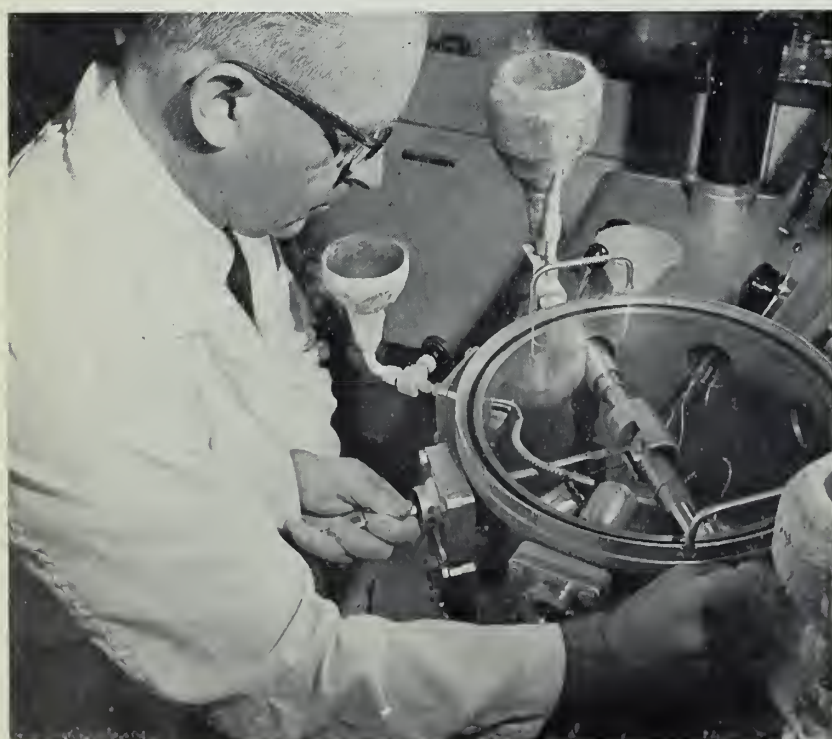
Steere's unit can be used to freeze-dry, freeze-fracture, and freeze-etch specimens for electron microscopy.

Also, rapid and precise manual temperature control can be maintained throughout the process.

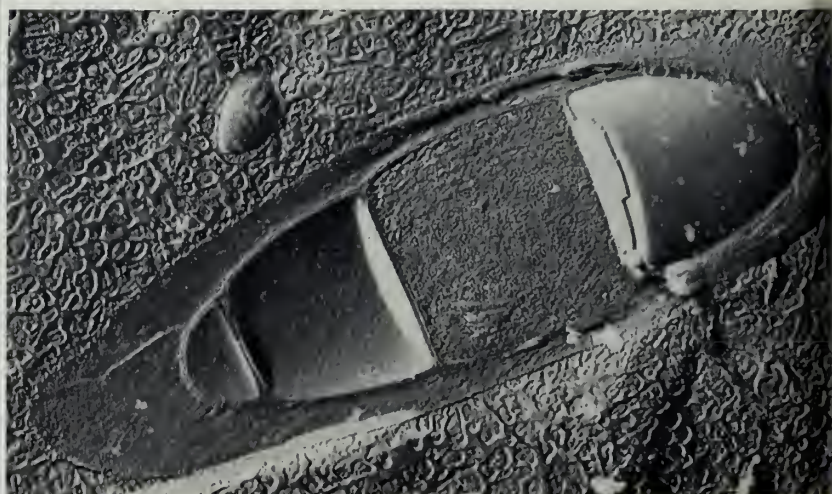
His technique consists of freezing specimens in water or such cryogenic freezing agents as glycerol and ethylene glycol. These agents protect specimens from freeze damage that might result if large ice crystals formed.

Frozen specimens are clamped to a small plate in the module, and a very high vacuum is obtained while specimen temperature is held at -196°C . Then the specimen is split or fractured with a remote-controlled, knife-edged probe. The fracture exposes different planes and parts of the specimen.

After fracturing, the temperature is raised to -98°C . At this temperature, a thin layer of ice (about a millionth of an inch) vaporizes from the exposed surface. Then a layer of platinum is deposited at an angle on



Left: Steere moves probe to fracture specimen in module. Vapor from liquid nitrogen, poured into funnels to cool specimen, rises from funnel at top center (ST-4261-7). Below: Micrograph of a freeze-fractured algal strand. Right to left are outside membrane of first cell, cross-fractured cell and two cell components (PN-1771).



Important tool in electron microscopy now faster·more versatile

the specimen, much as snow falls on a fence, coating only one side. Next a layer of carbon is applied vertically as the specimen is rotated, and the carbon forms a film or mold that holds the platinum in place.

Once the platinum-carbon cast has been formed, the specimen is removed from the module and placed in a chromic acid bath to dissolve the specimen, leaving only the mold or replica.

Unfractured cells not bathed in acid have survived the procedures with 90 percent viability. This means that the replicas provide electron microscope observations and photographs that are true representations of specimens in living form.

The new modules are now available commercially, but Steere is continuing his studies to develop even more refined equipment.■

Below: Steere removes replica from chromic acid bath after freeze-fractured specimen has dissolved. The mold or replica was left (ST-4260-7). Unfractured cells not bathed in acid have survived the procedures with 90 percent viability.



Star Grass for latin america

HELP FOR Latin America in boosting production of needed animal protein may come from star grass pastures.

In the humid regions of Puerto Rico, grazing studies showed that star grass (*Cynodon plectostachus*) was superior in all comparisons to pangola, heretofore the most productive grass in those areas.

Except in its native Africa and some areas of Australia and Central America, star grass has previously been grown only on small ungrazed plots at experiment stations.

ARS agronomist Ruben Caro-Costas, conducted the studies on steep Cialitos clay soil at Orocovis. The Puerto Rico Agricultural Experiment Station cooperated.

Caro-Costas found that star grass carried more animals per acre and produced more beef than did pangola, and daily gains were higher. Star averaged 1,266 pounds of beef per acre on three pastures, as compared with 838 pounds for pangola. Star also carried 2.87 head per acre; pangola, 2.27.

Analysis of forage samples showed that star grass had a higher dry matter content at all seasons than pangola and usually had a higher percentage of leaves.

The star grass was ready for grazing earlier than pangola and sustained little damage from aphids, serious pests of pangola. In addition, star was not affected by stunt disease, which often reduces the yield of pangola.

Analysis showed that very young star grass has a rather high prussic acid content but levels drop rapidly with age. However, Caro-Costas grazed heifers, unfed for 36 hours, on star forage known to have high prussic acid content. They consumed high quantities of the grass, but no ill effects were noted.

Although further research is necessary, several farmers in Puerto Rico report excellent results with field-size plantings of star grass.■



Agricultural aid G. D. Vass handpicks apples from trees in treated plots. Tree is healthy, yield is high, and fruit superior in quality (PN-1772).

Herbicides in Orchards

economical, effective, and safe

HERBICIDES can be used season after season without injuring trees or reducing fruit quality, an 8-year research program shows.

Cooperative studies by ARS horticulturist W. V. Welker and agricultural aid G. D. Vass and horticulturist E. G. Christ of Rutgers—The State University, New Brunswick, N.J., indicate that herbicides are safe and effective when properly used, and they are more economical in orchards than any other weed-control method.

Even with applications year after year, the researchers found that herbi-

cide residues did not build up to cause any visible tree injury nor did they adversely affect fruit. Laboratory analyses showed no chemical residues in any fruit. ARS nutritionists at Beltsville, Md., concluded that fruit grown on herbicide-treated plots was equal in all respects to fruit from hand-weeded control plots.

In these studies, herbicides effectively controlled crabgrass, foxtail, pigweed, poison ivy, curly dock, plantain, and other weeds. The researchers evaluated diuron, simazine, terbacil, dalapon, paraquat, amitrole, diphen-

amid, and dichlobenil. Type of fruit and weed population determined the chemical used, dilution, and rate and time of application.

Weeds have been a continual problem in orchards. Each year weeds cause peach growers alone a loss of over 4 million bushels of potential fruit production. Weeds rob all fruit trees of nutrients and water, furnish protective cover for mice that chew bark and roots, and harbor insects that migrate onto the trees. Control the weeds, and these problems are controlled too.

When weeds are curbed by mowing or cultivation, machinery often breaks branches, scrapes off bark, and injures roots of fruit trees. All cultivation methods are relatively effective but expensive. They require costly manpower and must be repeated often. For example, peach orchards require weeding every 10 to 14 days during the 5-month growing season.

On the other hand, most herbicides need only single annual applications to be effective. Costs are low. The most expensive herbicide now recommended by the researchers can control weed growth in a 10- by 10-foot plot for about 2.5 cents a tree, plus the cost of equipment and labor. Some recommended herbicides cost less than a penny a tree a year.

In continuing studies, the researchers will look for selective, broad-spectrum, safe herbicides for use in combination with mechanical, ecological and biological methods of controlling weeds. They will also seek ways of improving herbicide effectiveness with herbicide rotation procedures and new chemical combinations and compounds. ■



Technician N. D. Erskine uses a cross-section measuring device to determine the water-carrying capacity of newly constructed graded furrows (PN-1773).

GRADED FURROWS

WITH PROPER land smoothing, graded furrow systems of land management may eliminate the need for some terraces and give farmers a more unobstructed field for multiple-row machinery.

Graded furrows are under study by ARS in Texas and Mississippi to increase the efficiency of field operations while protecting the soil from erosion.

At Temple and Riesel in the Texas Blackland Prairie, a system of graded furrows—mini-terraces—has successfully controlled erosion on fields with slopes up to 3 percent (that is, the field drops 3 feet per 100 foot length). Slopes as high as 10 percent have been studied at Holly Springs, Miss.

In the Temple research, the furrows were laid off with a 1-percent grade on a 7-acre area of 2- to 3-percent land slope. The furrows, 40 inches apart, were constructed with a middle-buster (lister without planting attachment). Field measurements indicated an average cross-sectional area of about 0.445 square foot in the furrows.

Diversion channels were built at the top and bottom of the field as well as at the borders. Space between the top and bottom channels was twice the recommended terrace spacing for the region.

Three separate areas included row lengths of 930, 520, and 340 feet. The diversion channels separate the areas and take care of any runoff if furrows are overtopped by extreme storms. Extreme storms occurred during the study but the furrows were not overtopped.

Use of the graded-furrow system demands that furrow ridges be maintained at all times, and modifications in planting and tillage methods are necessary. Row crops were planted on top of the ridges at Temple and Riesel. When cultivation was necessary, sweeps were adjusted to conform to the furrow shape to maintain the ridge. At Temple, a disk drill was used to plant oats, and the spring tension was adjusted to permit planting of furrow and ridges at the same time.

Agricultural engineer C. W. Richardson, hydraulic engineer R. W. Baird, and agricultural engineer D. W. Fryrear, who are conducting the ARS research in cooperation with the Texas Agricultural Experiment Station, report that areas in graded furrows have normally produced average to above-average crop yields.

Runoff and soil-loss data compiled from graded furrows up to 930 feet long indicate an increase in both runoff and soil loss with an increase in row length.

Soil losses from the 930-foot areas were tolerable for the Texas soils, but this row length is near the upper limit. By designing a system that permits water drainage both directions from a central point, row lengths near 2,000 feet are possible.

Research at the Blacklands Experimental Watershed in Riesel, Texas, will start on field-sized areas of land to get more information on designing graded furrow systems for the average farm.■

STICKY TRAPS baited with live male boll weevils look promising for detection, survey, and possibly control of this cotton pest.

Male weevils give off an attractant that is equally effective in luring both female and male weevils. Insects attracted to baited traps become entangled in the sticky coating and die.

The traps have the best immediate potential as a survey and detection tool to provide a more accurate, early warning of future infestations. They also show promise as a control device, particularly in newly infested areas or where control programs hold down weevils to fewer than 10 per acre. Such a low level has been achieved since 1964 by annual spray programs in areas where two ARS trapping tests were made.

In addition, the traps could provide new information vital to the success of future area-wide control programs. They could help pin down, for example, the time, distance, and rate at which weevils migrate.

ARS entomologists D. D. Hardee

and W. H. Cross reported best results in preliminary tests with 12 traps bordering a 35-acre cotton field. Weevils damaged less than 10 percent of the developing cotton buds, called squares.

In weekly surveys of the same field, cooperating Texas Agricultural Extension Service entomologist L. K. Almand reported discovery of live weevils only once before August 30. Nearby fields without traps incurred greater damage to squares and Almand found up to 6,000 boll weevils per acre.

Like all control measures, the traps have certain limitations. In a heavily infested area, large numbers of weevils in the field produced enough lure to mask that from weevils in the traps, thus reducing the weevil catch. The same limitation applies in other areas where high numbers of weevils develop in midseason. Traps remained effective, for example, in an area of low infestations in spring and fall, but not in midsummer when weevils migrated from heavily infested cotton

grown outside the area under test.

Performance of the traps is also affected by a behavior trait of the weevils, preliminary studies revealed. Weevils in the traps produced lure only when fed cotton squares or an artificial diet developed at the Boll Weevil Research Laboratory, State College, Miss.

Related tests show that certain colors make the traps more effective. Blue-green, yellow, or white traps attracted more weevils than did the green traps originally tested. Hardee and Cross found that the amount of reflected light, rather than the colors themselves, influenced response. However, traps painted red, no matter how bright, repelled the insects.

The entomologists also found that traps half the size of those used originally, and consequently less expensive, were equally effective in trapping weevils.

Further tests will be made to refine the trapping techniques and pin down their potential under different field conditions.■

caged weevils

sharpen detection tools

Hardee checks weevils caught in sticky coating on trap in cotton field. Cage in center of trap holds five weevils which give off lure. In three days, one trap captured 645 weevils (PN-1774).



AGRISEARCH NOTES

Skim Milk Made to Whip

Dried skim milk can now be whipped into a low-calorie dessert topping.

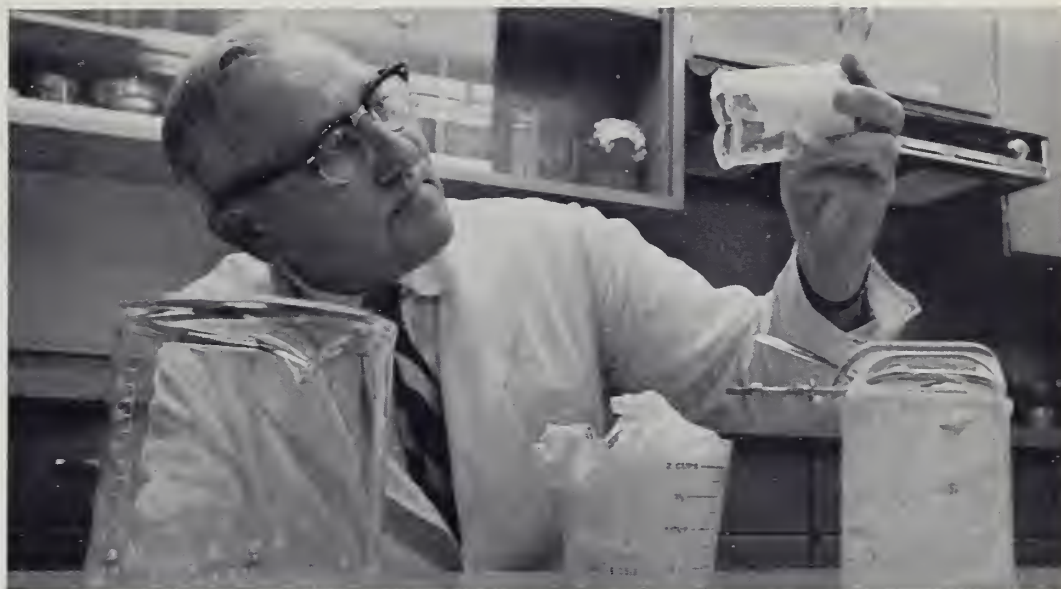
The key to whipping ability, ARS scientists found, was homogenization of the skim milk before drying it to a powder. When reconstituted with water and whipped, a brilliant white foam is produced which resembles stiffly beaten egg whites. The foam will hold its shape for over an hour, and whipping utensils may be at room temperature.

Although the foam has a bland taste, it may be sweetened with sugar or a sugar substitute and flavored by adding vanilla extract or fruit-flavored jam or jelly.

Each cup of the whipped topping has only about 55 calories, compared to 350 calories in an equal amount of whipped cream. One quart of topping can be whipped from one cup of the reconstituted skim milk.

Research on homogenized dried skim milk was conducted by chemists Arjen Tamsma, Arnold Kontson, and M. J. Pallansch of the Eastern utilization research laboratory, Washington, D.C.

Ability of the reconstituted milk to foam depends upon the pressure under which it is homogenized and the percent solids in the final product. The ideal foam was obtained when nonfat milk that had been homogenized at a pressure of 4,000 pounds per square inch was reconstituted with one part water to two parts dried powder by volume and whipped for 3 minutes. This method produced a rigid, self-supporting foam which contained 6 percent total solids.



Konston holds foam in beaker at an incline for stability test. He records how long it takes for foam to begin leaking fluid (ST-4473-8).

Homogenizing skim milk is an inexpensive process with few production problems. Homogenizing would give dried skim milk a dual purpose both as a fluid milk and as a whipped topping. And like conventional dried skim milk, the homogenized product does not require refrigeration.

Fescue, Clover Need Early Watering

Good stands of tall fescue and white clover, two excellent forage crops, depend on adequate moisture the first few days after seeds germinate.

If irrigation is available, a single watering can make up for lack of rain. Otherwise, the acreage should be reseeded as soon as possible. ARS researchers at Beltsville, Md., made these findings in studies of the relationship between the environment and the rapid development of tall fescue and white clover. That relationship is only partially understood for most grasses and legumes.

The ARS team seeded tall fescue

and white clover on three soils under a wide range of conditions, using both drilling and broadcasting. Drilling clearly proved the better seeding method.

Dry weather soon after germination was the main cause of poor stands and yields in each instance.

Fescue yields were lower on loamy sand than on clay loam or loam soils. White clover showed no significant variation on different soils but was hindered by competition for sunlight when drilled in the same row with fescue.

The experiments showed that white clover has a better chance for growth if seeding is done in summer, and fescue is not planted in the same row. A suitable method may be to drill clover and fescue in alternate rows, or to broadcast clover between drilled rows of fescue in a separate operation.

The researchers advise that tall fescue can be seeded anytime from March to October in the mid-Atlantic region, provided moisture is adequate

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for germination and that more rain falls in a few days. The likelihood of long dry periods can be determined by examining weather records for past years.

The experiments were conducted by agronomists R. H. Hart and G. E. Carlson and agricultural engineer H. J. Retzer.

Double Dawns Upset Insects

Light regulated to produce an "extra" sunrise and sunset upsets insects' rhythmic daily activities, slowing their rate of growth.

Moreover, their reproduction and other behavioral traits may be affected in ways that could make them easier to control with existing measures—and possibly smaller amounts of insecticide.

ARS entomologist W. N. Sullivan, biochemist D. K. Hayes and associates at Beltsville, Md., tripped up Madeira cockroaches and tobacco budworm larvae with variations of earlier lighting tests (AGR. RES., April 1968, p. 8). Using specially constructed chambers in which different day-lengths can be simulated with precision, the scientists turned on the lights at times of the night when the insects are particularly sensitive to light breaks.

One group of insects was adjusted to a routine of 12 hours of light and an equal period of darkness. In tests with another group of insects, lights were timed to turn on automatically for 15 minutes 2 hours after onset of

darkness and again 2 hours before daylight.

Roaches exposed to the extra sunset and dawn grew more slowly over a 6-month period, weighing about one-third less than roaches not treated to double sunsets and sunrises.

Such adverse results also occurred with another lighting regimen. It involved 12 hours of light and an equal interval of darkness run on a 4-day cycle, alternating with 4-day cycles of 18 hours of light and 6 hours of darkness.

Similar results were obtained with tobacco budworms. Other species of insect pests will be tested for the effects of various deviations in natural lighting conditions.

Citrus Disease Curbs Sought

Scientists studying a widespread citrus disease in India may provide an effective weapon against a citrus dieback syndrome called stubborn disease in the United States.

Working under a Public Law 480 grant, the Indian scientists have confirmed that the primary cause of citrus dieback in their country is a disease called greening. Stubborn disease, closely related to greening, has done serious damage to U.S. citrus; it is possible, says ARS sponsoring scientist L. C. Cochran, Beltsville, Md., that the two diseases are the same.

Both greening and stubborn are virus diseases. Infected trees show considerable stunting, leaf and fruit drop, and twig dieback. Severely affected trees produce bush-like stunted

growth and small, misshapen fruits with few seeds, most of which do not develop properly. There is no known treatment for greening, which is spread by plant lice called psyllids.

The psyllid species that spread greening disease in India are not found in the United States, but other psyllids are sometimes present in stubborn-infected U.S. orchards. Therefore, although the vector of stubborn has not yet been determined, psyllids have not been entirely ruled out.

In proving that greening was the primary cause of citrus dieback, the Indian scientists made over 500 grafts on 22 different test plant species. Greening disease developed in 31 percent of the grafts.

ARS has extended the work at the Indian Agricultural Research Institute, New Delhi, for a more detailed study of greening, particularly host reactions and method of spread. Hopefully, this continuing research will provide facts needed to control stubborn disease in the United States.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly



careful where there is danger to wildlife or possible contamination of water supplies.